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ABSTRACT

A bibliography and short historical background are provided within this description of the integrated science thrust in science education. Detailed are the philosophy and methodology as outlined by FUSE, the Federation for Unified Science Education. (CS)

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INTEGRATED SCIENCE, AN INTRODUCTION

AND BIBLIOGRAPHY

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INTEGRATED SCIENCE, AN INTRODUCTION AND BIBLIOGRAPHY

Introduction

It's known by various names, integrated science (Richmond, 1971), unified science (Adams, 1971), undifferentiated science (Munn, 1973) and others, but the proponents of this form of science education are certain that it has a promising future. Paul D. Hurd (1973) has given this explanation for the current emphasis on integrated science.

> Profound changes in society and increased dissonance in American culture; public disenchantment with science and suspicion of technology-these factors, combined with a prevailing lack of confidence in schools, signify the end of an educational era. Discipline-centered science curricula developed during the 1960s are being assessed as inappropriate for the 1970s and 1980s. The specialization reflected in conventional science courses not only limits an understanding of modern science but also the resolution of problems besetting society. A search is on for a higher order curriculum for science education, one which reflects the current challenges to science and technology and is more sensitive to mankind's present and future conditions. (p. 18)

Of course the interest in integrated science has not been confined to the United States or even to the "developed" nations. In fact, one of the strongest proponents of integrated science in the past decade has been

UNESCO. Mary Hawkins (1973), reporting on the International Conference on the Education of Teachers for Integrated Science held at the University of Maryland in April, 1973, gives this explanation for UNESCO's interest in integrated science.

> With its concern for the developing countries, UNESCO strongly promotes integrated science. Since very few students go on to high school and university in the developing countries, the knowledge that a student picks up about science and its methods has to be gained in the elementary school where the instructors, as in this country, are generalists rather than specialists in one of the sciences. Teaching science in an integrated way seems very natural under these circumstances. Even at the high school level, schools often cannot afford both a physics and a chemistry teacher. Hence teaching these subjects in an integrated way seemed a logical solution. (p. 44)

The UNESCO definition of integrated science is those "approaches in which the concepts and principles of science are presented so as to express the fundamental unity of scientific thought and to avoid premature or undue stress on the various scientific disciplines" (Richmond, 1974). Paul D. Hurd enlarged upon this definition at the April, 1973 conference in describing integrated science as "a science program for general education for the masses of people for understanding contemporary affairs and conditions in science; it provides a powerful curriculum and is more in tune with the times than traditional approaches" (Richmond, 1974).

Philosophy and Methodology

The philosophy underlying integrated science has best been expressed by FUSE, the Federation for Unified Science Education, founded in 1966 at Ohio State University. FUSE believes that a general education in science for all young people should be the goal of all science programs in K-14. FUSE believes this goal can best be achieved through locally developed unified (integrated) science programs (Showalter, 1973). Victor Showalter (1973) has given the philosophy behind the FUSE approach to integrated science.

> A unified science approach offers an opportunity to develop programs that can enable the learner to view science as a single humanistic effort, to understand the full scope and limitations of science, to avoid repetition of subject matter, to learn science in a greater variety of ways than are permitted in traditional courses, and to develop a positive attitude toward science. (p. 26)

FUSE has formulated guidelines for an idealized science unit. These guidelines incorporate most of the current trends in integrated science education.

1) be organized around a theme which is either: (a) a big idea (concept) that permeates all sciences, (b) a process of science, (c) a natural phenomenon, or (d) a problem.
2) incorporate learning activities from several specialized sciences including one or more of the behavioral or social sciences.

3) be based on a few clearly stated objectives in learner terms and which are consistent with overall program objectives.

4) provide learning activities for 4-8 weeks of usual school time.

5) incorporate a variety of learning modes, many of which include "concrete" experiences.

6) be essentially self-contained, yet be an integral part of the local science program. It should be interesting to and usable by learners at a specified grade level.

7) include an end-of-unit test based on achievement of unit objectives and should contain only a few (if any) items of a purely recall nature.

8) utilize a format that will lend itself to continuing evolution of the unit in time.

9) contain opportunities for learners to make some choices of what and how they learn.

10) utilize commonly available equipment and materials, require a minimum expenditure for special equipment and materials, be compatible with local constraints, and capitalize on existing resources.

11) be prefaced by a rationale which is addressed to both learners and teachers and which describes reasons for the unit's importance, interest, etc.

12) include several opportunities for learners to self-check their progress toward achieving the goals.

13) be accompanied by a brief description of the teacher's role in teaching the unit.

14) identify the source of the learning activities used in building the unit. Activities adapted from or located in other sources should be clearly linked to the unit.

15) include a list of materials and resources required in the unit and their source or location.

16) be accompanied by an accurate estimate of the man-hours of effort required to assemble the unit.

(Thomson, 1975, p. 109)

Progress

In 1969 there were 30 curriculum projects in the United States that could be defined as integrated (Adams, 1971). In 1972, the Eighth Report of the International Clearinghouse of Science and Mathematics Curriculum Development listed 65 integrated science projects in the United States plus nearly 30 similar projects outside the U.S. (Lockard, 1972). By 1974, the 9th Report of the Clearinghouse was listing some 122 integrated science projects in the United States. A similar increase was shown worldwide (Lockard, 1974). Current trends do not show any decrease in these figures. Two of these projects will be discussed here.

The Portland Project was initiated in 1967 at the University of Oregon as a 3-year science program incorporating biology, chemistry, physics, behavioral science, environmental science and mathematics for 14-17 year olds. Three modes of integration underlie the program: logical content sequence, the heuristics of science as an integrator, and integration of

content around enviornmental problems. This project is considered to be unique since it was one of the earliest attempts at integration and was formulated and implemented locally. In 1974 it was being utilized in 18 schools by nearly 2400 students (Lockard, 1974).

As a second example, the British Open University was conceived as a social experiment to bring a university education within the reach of a large segment of the British population. Courses are conducted by radio, television, and local study centers. The Science Foundations course which is integrated and multidisciplinary in nature serves as an introduction to science for science and non-science majors. The broad aims of the course are to "present and explain some concepts and principles that are important in modern science and to show how science, technology and society are interrelated." The course lasts one year and has been extremely successful and has attracted worldwide attention (Lockard, 1972; Munn, 1973).

An extensive listing and description of projects can be found in the 8th, 9th and 10th Reports of the International Clearinghouse on Science and Mathematics Curriculum Development (Lockard, 1972, 1974, 1977).

Summary

The acceptance of integrated science is on the increase as can be interpreted by the mushrooming number of projects that are being used worldwide. There are those who criticize the whole concept (Chappell, 1970), but by and large the greatest hindrance to continued growth and success is the "lack of adequately prepared and competent teachers" (Hawkins, 1973, p. 46). It is envisioned that this problem will be eliminated as more and better materials become available and as teacher training programs increasingly emphasize an integrated science approach.

Bibliography

Adams, T. W. A review of unified science and the high school. School Science and Mathematics, 1971, 71, 495-500.

Brown, T. L. The integrated undergraduate laboratory programs at Illinois. The Journal of Chemical Education, 1972, 49, 633-635.

Chapman, B. The integration of science or the disintegration of science education. The School Science Review, 1976, 58, 134-146.

Chappell, W., et al. New curricula for today. Education Digest, 1970, 35, 38-41.

Chisman, D. G. Teaching integrated science. The Science Teacher, 1973, 40, 20-22.

Cochran, J. C. The integrated undergraduate laboratory at Colgate. Journal of Chemical Education, 1972, 49, 630-633.

Connally, D. On the integration of school learning. Education Canada, 1972, 12, 23-27.

Fertitta, N. V. K-12 unified science approach. School Science and Mathematics, 1975, 75, 65-69.

Fiasca, M. A. Integration of the sciences. American Biology Teacher, 1970, 32, 225-226.

Gadsden, T., Jr., et al. Cutting boundaries with correlated science. School Science and Mathematics, 1975, 75, 80-86.

Gardner, M. A myriad of patterns on the international scene. School Science and Mathematics, 1975, 75, 69-79.

Hall, W. C. Patterns-The schools council integrated science project. School Science and Mathematics, 1975, 75, 115-120.

Hawkins, M. Reporting on the international conference on the education of teachers for integrated science. The Science Teacher, 1973, 40, 43-46.

Hayden, M. F. A 2-year integrated physics-chemistry course. The Physics Teacher, 1970, 8, 135-136.

Hayward, O. T. Integrated science-The untidy field. The Science Teacher, 1973, 40, 32-33.

Herr, L. G. Unified science: A solution to physics enrollment. The Physics Teacher, 1971, 9, 248-252.

Hurd, P. D. Integrated science. The Science Teacher, 1973, 40, 18-19.

Johnson, G. An integrated 2-year chemistry-physics course compared with consecutively taught separate courses. Science Education, 1972, 56, 143-154.

Lockard, J. Eighth Report of the International Clearinghouse in Science and Mathematics Curriculum Development. College Park: University of Maryland, 1972.

Lockard, J. Ninth Report of the International Clearinghouse in Science and Mathematics Curriculum Development. College Park: University of Marlyand, 1974.

Lockard, J. Tenth Report of the International Clearinghouse in Science and Mathematics Curriculum Development. College Park: University of Maryland, 1977.

Munn, R. J. Integrated science: The British open university approach. The Science Teacher, 1973, 40, 27-28.

Richmond, P. E. Approaches to integrated science teaching. School Science Review, 1974, 55(192), 591-595.

Richmond, P. E. (editor). New Trends in Integrated Science Teaching. Volume 1, 1971, UNESCO.

Richmond, P. E. (editor). New Trends in Integrated Science Teaching. Volume 2, 1973, UNESCO.

Richmond, P. D. (editor). New Trends in Integrated Science Teaching. Volume 3, 1974, UNESCO.

Schatz, V. and A. Schatz. How soils are formed and become fertile, an example of an integrated science unit. School Science and Mathematics, 1972, 72, 484-490.

Schwartz, C. C. Let's do away with high school courses in earth science, biology, chemistry and physics. The Physics Teacher, 1971, 9, 65-66.

Showalter, V. Unification of the curriculum. in Encyclopedia of Educational Research, Volume 8, (editor Lee C. Deighton), New York, McMillan and Company, 1971.

Showalter, V. The FUSE approach. The Science Teacher, 1973, 40, 25-27.

Showalter, V. Rationale for an unbounded science curriculum. School Science and Mathematics, 1975, 75, 15-21.

Showalter, V. Unified science education programs and materials. Occasional Paper Series, Science Paper 10, Science Education Information Reports. ERIC Information Analysis Center, Columbus, Ohio, May 1973.

Showalter, V. and I. Slesnick. Program development in unified science. The Science Teacher, 1961, 28, 54.

Supinski, R. and M. Szabo. A survey of unified science enrollment. A paper presented at the National Convention of the Federation of Unified Science, 1974.

Taiwo, A. A. An appraisal of the Nuffield science project. Science Education, 1973, 57, 479-483.

Thomson, B. FUSE and the center for unified science education. School Science and Mathematics, 1975, 75, 109-114.

Ward, R. W. Unified science, a workable approach. Science Education, 1969, 53, 137-140.

William, R. B. A method of integrating chemistry subject matter into biological science instruction. Science Education, 1975, 59(2), 167-175.